**What is claimed is:**

1. A method of manufacturing a rigid foam comprising:

preparing a polymer melt;

incorporating nano-particles into the polymer melt;

incorporating a blowing agent into the polymer melt under a first pressure and at a first temperature;

extruding the polymer melt under a second pressure and at a second temperature, the second pressure and second temperature being sufficient to allow the polymer melt to expand and form a foam; and

cooling the foam to form a foam product having an average cell size, a cell size distribution, an average cell wall thickness, an average cell strut diameter, a cell orientation, a thermal conductivity, a foam density and a foam strength.

2. A method of manufacturing a rigid foam according to claim 1, wherein:

the polymer includes a major portion of at least one alkenyl aromatic polymer selected from a group consisting of alkenyl aromatic homopolymers, copolymers of alkenyl aromatic compounds and copolymerizable ethylenically unsaturated co-monomers.

3. A method of manufacturing a rigid foam according to claim 2, wherein:

the polymer includes a major portion of at least one alkenyl aromatic polymer selected from a group consisting of the polymerization products of styrene, α-methylstyrene, chlorostyrene, bromostyrene, ethylstyrene, vinyl benzene, and vinyl toluene; and

a minor portions of a non-alkenyl aromatic polymer.

4. A method of manufacturing a rigid foam according to claim 3, wherein:

the polymer includes at least 80 wt% polystyrene.

5. A method of manufacturing a rigid foam according to claim 2, wherein:

the blowing agent includes at least one composition selected from a group consisting of aliphatic hydrocarbons having 1-9 carbon atoms, halogenated aliphatic hydrocarbons having 1-4 carbon atoms, carbon dioxide, nitrogen, water, azodicarbonamide and p-toluenesulfonyl.

6. A method of manufacturing a rigid foam according to claim 5, wherein:

the blowing agent includes at least one composition selected from a group consisting of methane, methanol, ethane, ethanol, propane, propanol, n-butane and isopentane, carbon dioxide, nitrogen, water, azodicarbonamide, p-toluenesulfonyl, HCFC-142b and HCFC-134a.

7. A method of manufacturing a rigid foam according to claim 2, further comprising:

incorporating an additive into the polymer melt before forming the foam.

8. A method of manufacturing a rigid foam according to claim 7, wherein:

the additive includes at least one composition selected from a group consisting of flame retardants, mold release agents, pigments and fillers.

9. A method of manufacturing a rigid foam according to claim 2, wherein:

the nano-particles have a minimum dimension of less than about 100 nm and are selected from a group consisting of calcium carbonate, intercalated clays, intercalated graphites, exfoliated clays and expanded graphites.

10. A method of manufacturing a rigid foam according to claim 9, wherein:

the nano-particles are incorporated into the polymer melt at a rate of between 0.01 and 10 weight percent, based on polymer weight.

11. A method of manufacturing a rigid foam according to claim 9, wherein:

the nano-particles are incorporated into the polymer melt at a rate of between 0.5 and 5 weight percent, based on polymer weight.

12. A method of manufacturing a rigid foam according to claim 11, wherein:

the nano-particles include a major portion of nano-Montmorillonite (MMT); and

the polymer includes a major portion of polystyrene (PS), polyethylene (PE) or polymethyl methacrylate (PMMA).

13. A method of manufacturing a rigid foam according to claim 10, wherein:

the nano-particles are formed by a technique selected from a group consisting of intercalation with polystyrene, in-situ polymerization of polystyrene (PS) or polymethyl methacrylate (PMMA) with a surface modified nano-Montmorillonite (MMT), and exfoliation of expandable graphite particles in a polystyrene or polymethyl methacrylate matrix.

14. A method of manufacturing a rigid foam according to claim 2, wherein:

the average cell size is less than about 500 μm;

the average cell wall thickness is less than about 10 μm;

the average strut diameter is less than about 20 μm;

the cell orientation is between about 0.5 and 2.0; and

the foam density is less than about 100 $kg/m^3$.

15. A method of manufacturing a rigid foam according to claim 14, wherein:

the average cell size is between about 60 and about 120 μm;

the average cell wall thickness is between about 0.2 and about 1.0 μm;

the average strut diameter is between about 4 and about 8 μm;

the cell orientation is between about 1.0 and about 1.5; and

the foam density is between about 20 and about 50 $kg/m^3$.

16. A method of manufacturing a rigid foam according to claim 2, further comprising:

incorporating a conventional nucleation agent into the polymer melt at a rate of less than about 2 weight percent based on polymer weight.

17. A method of manufacturing a rigid foam according to claim 16, wherein:

the cell size distribution is bimodal, with a first peak centered between about 50 μm and 120 μm and a second peak centered above 200 μm.

18. A rigid foam comprising:

at least about 80 weight percent of a polymer matrix including a major portion of at least one alkenyl aromatic polymer selected from a group consisting of alkenyl aromatic homopolymers, copolymers of alkenyl aromatic compounds and copolymerizable ethylenically unsaturated co-monomers; and

less than about 10 weight percent nano-particles having a minimum dimension of less than about 100 nm;

the polymer matrix being further characterized by

an average cell size of between about 60 and about 120 μm;

an average cell wall thickness of between about 0.2 and about 1.0 μm;

an average strut diameter of between about 4 and about 8 μm;

a cell orientation is between about 1.0 and about 1.5; and

a foam density of between about 20 and about 50 $kg/m^3$.

19. A rigid foam according to claim 18, wherein:

the polymer matrix is further characterized by

a foam compressive strength of at least 300 kPa according to ASTM D1621.

20. A rigid polymer foam according to claim 18, wherein:

the cell orientation is at least 1.2; and

further wherein at least 90 % of the cells are closed cells.